

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0741 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 3 02/20/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: TRANSDUCER STATHAM	ME449-0177-8179

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TRANSDUCER, ENGINE HELIUM SUPPLY PRESSURE

REFERENCE DESIGNATORS: V41P1150A
V41P1250A
V41P1350A

QUANTITY OF LIKE ITEMS: 3
ONE PER ENGINE HE SUPPLY

FUNCTION:

PROVIDES PRESSURE INDICATION FOR MPS ENGINE HELIUM SUPPLY. ALSO USED BY THE BACK-UP FLIGHT SOFTWARE (BFS) TO DETERMINE IF THERE IS EXCESSIVE HELIUM USAGE/LEAKAGE ON THAT ENGINE SYSTEM. LOCATED ON THE LINE BETWEEN THE SUPPLY TANK AND THE SUPPLY ISOLATION CHECK VALVES (CV25,26,36,37,41,42).

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0741-01

REVISION#: 1 10/30/01

SUBSYSTEM NAME: MAIN PROPULSION

LRU: GHE SSME SUPPLY PRESSURE TRANSDUCER

CRITICALITY OF THIS

ITEM NAME: GHE SSME SUPPLY PRESSURE TRANSDUCER

FAILURE MODE: 1R2

FAILURE MODE:

ERRONEOUS INDICATION (READS LOW).

MISSION PHASE: LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:

PIECE PART STRUCTURAL FAILURE, CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) PASS
	C) PASS

PASS/FAIL RATIONALE:

A)

B)

PASSES B SCREEN BECAUSE HELIUM USAGE CAN BE CONFIRMED USING HELIUM SUPPLY TEMPERATURE TRANSDUCERS.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

DURING ASCENT, FOR ERRONEOUS INDICATIONS LESS THAN 1150 PSIA OR SUFFICIENT TO CAUSE VIOLATION OF C&W DP/DT LIMIT, PILOT WILL BE PROMPTED TO PERFORM HELIUM LEAK ISOLATION PROCEDURE. FOR ERRONEOUS INDICATIONS LESS THAN 1150 PSIA, PILOT WILL BE PROMPTED TO INTERCONNECT THE PNEUMATIC HELIUM SUPPLY. NEITHER ACTION IS REQUIRED PRIOR TO SUBSEQUENT HELIUM SYSTEM PROBLEM. RESULTS IN

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0741-01**

LOSS OF CONTINUOUS PRESSURE MONITORING CAPABILITY FOR ONE ENGINE'S HELIUM SUPPLY.

LCC MONITORED FROM COMPLETION OF MPS HELIUM TANK PRESSURIZATION TO T-13 SECONDS.

(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECTS:
1R/2 2 SUCCESS PATHS, TIME FRAME - ASCENT.
1) ERRONEOUS LOW OUTPUT FROM HELIUM TANK PRESSURE TRANSDUCER SUCH THAT TANK PRESSURE OR DP/DT C&W ALARM IS ACTIVATED.
2) ANY FAILURE WHICH RESULTS IN NO FLOW THROUGH A SINGLE REGULATOR LEG ON THE SAME ENGINE (I.E., ISOLATION VALVE FAILS TO REMAIN OPEN, FILTER CLOGS, DOWNSTREAM CHECK VALVE FAILS TO REMAIN OPEN).

WHEN THE SYSTEMS MANAGEMENT (SM) ALARM SOUNDS, THE MISSION PILOT WILL LOOK AT THAT ENGINE'S A AND B LEG REGULATOR PRESSURES. WHEN NEITHER PRESSURE INDICATES OFF-NOMINAL, THE PILOT WILL FOLLOW NORMAL PROCEDURE AND CYCLE EACH ISOLATION VALVE IN TURN. THIS ACTION RESULTS IN TERMINATING THE HELIUM FLOW TO THE ENGINE AND POSSIBLE UNCONTAINED ENGINE SHUTDOWN.

POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE TRANSDUCER UTILIZES A STRAIN GAGE PRESSURE MONITORING CONCEPT. A BEAM WITH A STRAIN GAGE IS CONNECTED TO THE SENSING DIAPHRAGM WITH A LINKAGE PIN. THE DIAPHRAGM DEFLECTION DUE TO PRESSURE CHANGES IS TRANSMITTED TO THE BEAM THROUGH THE LINK PIN CAUSING BEAM DEFLECTION. THE STRAIN GAUGE WILL MEASURE THIS DEFLECTION.

LEAD WIRES CONNECT THE STRAIN GAUGE TO A STATIONARY YOKE (STAINLESS STEEL). NICKEL LEADS CONNECT THE STATIONARY YOKE TO THE FEEDTHROUGH CONNECTOR AND ARE CONFORMAL COATED WITH PARALENE. MATERIALS AND PROCESSES USED ARE

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0741-01**

COMPATIBLE WITH THE ENVIRONMENTAL CONDITIONS. THE TRANSDUCER IS CAPABLE OF WITHSTANDING 1.5 TIMES MAXIMUM OPERATING PRESSURE WITHOUT CHANGING THE CALIBRATION.

THE CASE ASSEMBLY, INCLUDING THE FEEDTHROUGH TERMINALS, IS EVACUATED AND SEALED BY WELDING A BALL INTO THE LEAK CHECK PORT. THE INTERNAL VACUUM IS USED AS A REFERENCE CONDITION FOR PSIA TRANSDUCERS.

ERRONEOUS OUTPUT (HIGH OR LOW) IS DEFINED AS THE TRANSDUCER FALSELY INDICATING A PRESSURE HIGHER OR LOWER THAN THE ACTUAL PRESSURE. ERRONEOUS OUTPUT (LOW) CAN BE CAUSED BY DIAPHRAGM LEAKAGE OR EXTERNAL LEAKAGE INTO THE VACUUM CASE. ERRONEOUS OUTPUT (HIGH OR LOW) CAN BE CAUSED BY STRAIN GAUGE OR CIRCUIT FAILURE WITHIN THE TRANSDUCER. "STICTION" TYPE FAILURE OF THIS TRANSDUCER IS CONSIDERED NON CREDIBLE DUE TO THE SMALL TRAVEL OF THE DIAPHRAGM (0.001 INCH).

(B) TEST:
PRE-ATP

THERMAL CYCLE
WITH POWER APPLIED, CYCLE BETWEEN -250 DEG F AND +350 DEG F SIX TIMES STAYING 2 HOURS AT EACH TEMPERATURE. DURING EACH 2 HOUR PERIOD, CYCLE PRESSURE FROM 0 TO 75 PERCENT MINIMUM OF FULL SCALE (FULL SCALE IS 0 TO 5000 PSIA) TWICE EACH HOUR.

ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE
PRIMARY AND SECONDARY BARRIER
1.5 TIMES MAXIMUM OPERATING PRESSURE

PERFORMANCE TESTS

INSULATION RESISTANCE

CALIBRATION
0, 20, 40, 60, 80, 100, 80, 60, 40, 20 AND 0 PERCENT OF FULL SCALE PRESSURE (5000 PSIA) AT -250 DEG F, +70 DEG F, AND +350 DEG F. RECORD ERROR DUE TO TEMPERATURE EFFECTS, LINEARITY, RESIDUAL IMBALANCE, REPEATABILITY, AND SENSITIVITY.

THE TRANSDUCERS ARE RE-CALIBRATED PERIODICALLY PER OMRSD REQUIREMENTS

CERTIFICATION

BY SIMILARITY

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0741-01**

THE TRANSDUCER WAS CERTIFIED BY SIMILARITY, DESIGN ANALYSIS, AND TESTING, AND IS SIMILAR IN DESIGN AND CONSTRUCTION TO TRANSDUCERS CERTIFIED BY BELL AEROSYSTEMS, MCDONNELL DOUGLAS, GENERAL ELECTRIC, AND MARTIN MARIETTA. THE PREVIOUS TEST LIMITS EXCEEDED ORBITER SPECIFICATION REQUIREMENTS.

BY TEST

OFF-LIMITS VIBRATION TESTING WAS SUCCESSFULLY PERFORMED WITH NASA DESIGN AND RELIABILITY CONCURRENCE ON AN ME449-0179-0173 TRANSDUCER AFTER REDESIGN FOR THE HIGHER VIBRATION ENVIRONMENT EXPERIENCED BY SOME MPS PRESSURE TRANSDUCERS.

BURST TEST

PRIMARY AND SECONDARY BARRIER
MINIMUM OF 3 TIMES MAXIMUM OPERATING PRESSURE

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

ALL RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL IS VERIFIED TO 100A. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY PER REQUIREMENTS. TOOL CALIBRATION IS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCESS.

CRITICAL PROCESSES

THE FOLLOWING ARE VERIFIED BY INSPECTION:

SOLDERING
HEAT TREATMENT
PARTS PASSIVATION
WELDING

TESTING

ATP, INCLUDING PROOF PRESSURE TEST, IS OBSERVED AND VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

HELIUM LEAK TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0741-01**

SPECIAL HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED BY INSPECTION TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING, TRANSPORTING, AND PACKAGING BETWEEN WORK STATIONS.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:

NONE.

- APPROVALS -

S&R ENGINEERING	: L. DANG	:/S/ L. DANG
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: HERB WOLFSON	:/S/ HERB WOLFSON
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
INSTRUMENTATION	: BILL MCKEE	:/S/ BILL MCKEE
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS